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BCStats

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June 2009
Issue: 2009-2

Environmental Statistics ◆ June 2009

Giving Dead Wood New Life: Salvaging BC's Beetle-Killed Timber

Over the last decade, British Columbia's pine forests have been exposed to the worst mountain pine beetle infestation in history. The pine beetle epidemic has not only wreaked havoc on BC's forests, but threatens to become an economic hardship for many BC communities.

Background

The mountain pine beetle is a tiny insect about the size of a grain of rice, which propagates by laying eggs under the bark of lodgepole pine trees. The larvae that hatch from the eggs feed on the tissue beneath the bark, thus cutting off the supply of water and nutrients to the tree. The tree's natural defence is to release a pitch flow that is toxic to the beetles; however, the beetles carry spores of a fungus that they release into the tree, which stops the spread of the toxic pitch and enables the larvae to continue to mine the area beneath the bark. This fungus is the cause of the distinctive blue stain that is present in wood harvested from pine beetle-killed trees. Once the host tree is dead, the beetles carry the fungus spores to other trees.

It takes literally hundreds of beetles to kill a lodgepole pine. Normally the beetles attack only weakened trees and mature pine 80 years or older; however, when conditions are right they can also spread to younger trees. A combination of environmental and human factors have resulted in just these types of conditions in British Columbia over the last several years, which has contributed significantly to the mountain pine beetle epidemic afflicting the province's pine forests.

Climate change has had a substantial impact on pine beetle populations. Unusually warm, dry summers and mild winters have created optimal conditions for the mountain pine beetle. The warm, dry summers leave pine trees stressed from lack of water, making them more susceptible to attack. Normally, the beetle population would be kept in check by cold winter temperatures, but in recent years temperatures have not been cold enough to kill off enough of the beetles. A winter temperature of minus 40 degrees Celsius sustained over several days or a cold snap of minus 25 degrees in the late fall or early spring are necessary to sufficiently reduce the beetle population to normal (non-epidemic) levels.

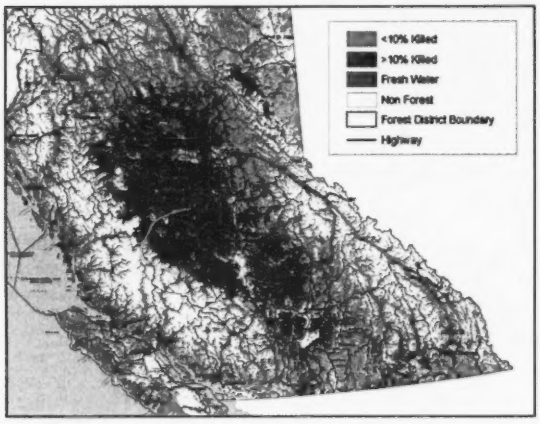
In addition to climate, fire suppression policies have also contributed to the beetle outbreak. Fire suppression has resulted in large stands of mature pine trees, which are more vulnerable to attacks by pine beetles. According to the BC Ministry of Environment, as a result of fire suppression efforts, there are three times as many mature lodgepole pines in BC's interior forests compared to a hundred years ago.[1]

[1] BC Ministry of Environment (http://www.env.gov.bc.ca/soe/et07/pinebeetle.html)

How severe is the problem?

The mountain pine beetle in BC ranges north to south from Fort St. John to the US border and west to east from Terrace to the Alberta border. The total area of the province that is affected to some degree by beetle-killed trees in either the red-attack or grey-attack stage[2] is estimated at 14.5 million hectares, which is more than four times the size of Vancouver Island.[3]

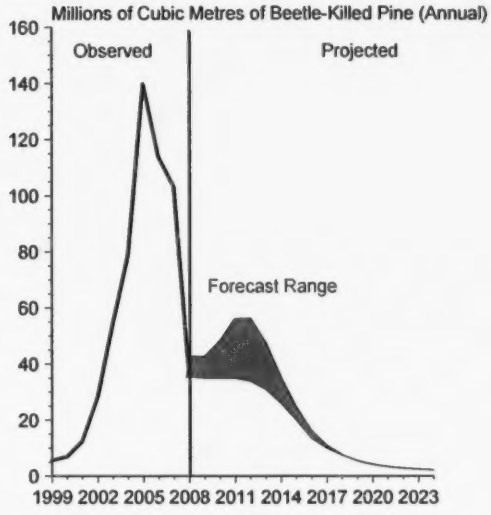
BC Mountain Pine Beetle Epidemic, 2008



Map source: BC Ministry of Forests and Range

Based on estimates and forecasts from the BC Ministry of Forests and Range, the peak of the mountain pine beetle's destruction of BC's pine forests has already occurred. Over the next several years, the amount of newly killed trees is expected to continue to trend down, mainly due to the fact that there will be fewer healthy trees left.

The peak of the mountain pine beetle's devastation has already occurred in BC



Source: Ministry of Forests and Range
(BCMPB.v6 No Management Scenario Forecast)

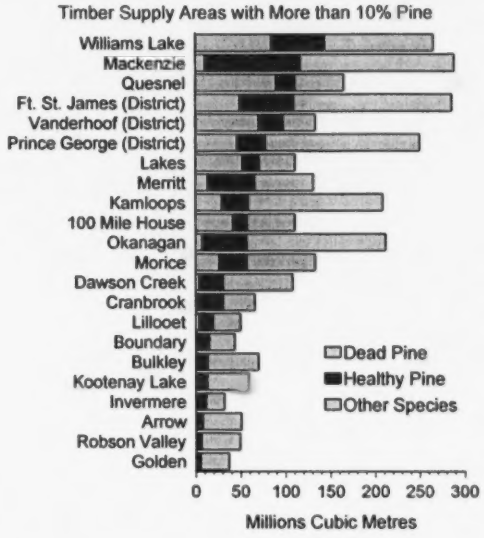
In some regions of the province, as much as two-thirds of the pine trees were already infested as of 2008. Overall, of those regions where more than ten percent of the forested area consists of pine, it is estimated that 46 percent of the pine trees were in the red or grey stages of attack by 2008. The worst hit area was the Quesnel Timber Supply Area (TSA), where approximately 81 percent of the pine was beetle-killed. The Vanderhoof Forest District (72%) and Lakes (73%) and 100 Mile House (72%) TSAs also had more than two-thirds of their pine already ravaged by the pine beetle.

By coincidence, these regions also have some of the largest ratios of pine to total timber volume. In the Vanderhoof Forest District, 73 percent of the total timber volume is comprised of pine. In the Quesnel TSA, the ratio is 67% and the Lakes (64%) and 100 Mile House (52%) TSAs also have large percentages of pine in their forests.

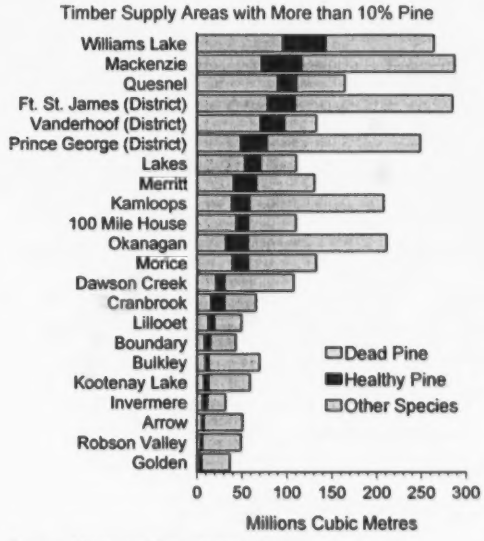
[2] Trees turn red about one year after being attacked. They stay in this "red-attack" stage for one to two years, then turn grey as they lose their needles.

[3] Source: BC Ministry of Forests and Range (www.for.gov.bc.ca/hfp/mountain_pine_beetle/facts.htm)

Several of the more pine-dependent regions of the province have already seen the bulk of their pine forests destroyed by the pine beetle (2008)



By 2015, most regions of the province are expected to have lost close to two-thirds or more of their pine forests to the mountain pine beetle



Source: Ministry of Forests and Range
(BCMPB.v6 No Management Scenario Forecast)

The BC Ministry of Forests and Range projects that by 2015, approximately 68% of BC's pine trees (in those regions where pine comprises more than 10 percent of timber volume) may be killed by the mountain pine beetle.[4] In regions where there is currently less than 10 percent infestation, there could be a kill rate of over 50 percent by 2015.[5]

The economic consequences of the destruction of BC's pine forests are potentially quite severe. The economies of several of the worst hit areas coincidentally also have substantial dependence on the forest sector. Among British Columbia's forest districts, the top five in terms of economic dependency on the forest sector are all in the region most affected by the pine beetle infestation. Mackenzie tops the list with 73% of the district's after-tax income in 2006 derived from the forest sector and 70% of basic employment provided by forest sector industries.[6] It is estimated that Mackenzie has so far had less than 10% of its pine trees affected by the pine beetle infestation, but the district has one of the largest supplies of pine in the province and it is projected to lose almost two-thirds of its pine to the beetle epidemic by 2015.

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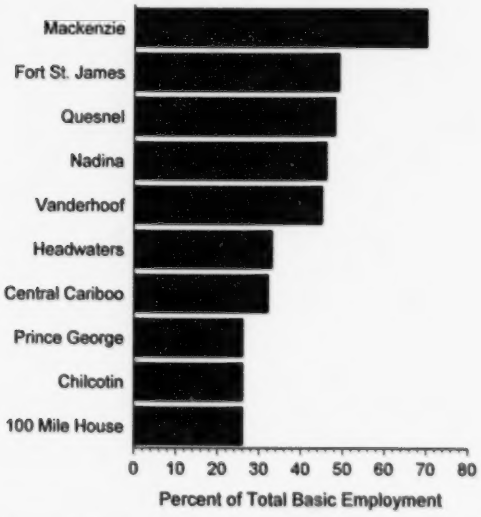
[4] This is a "no management scenario" forecast; in other words, this is the damage that would occur from infestation only, with no harvesting of the timber.

[5] It should be emphasized that this is a projection and, as with any projection, there are many factors that could impact the numbers. Factors contributing to the uncertainty around projecting pine mortality include reduced influx from those areas worst hit by the beetle, marginal climatic suitability, mixed tree types, and larger topographic barriers to beetle movement.

[6] The source of all income and employment dependency figures quoted in this and the following paragraph is: Horne, Garry (March 2009), *British Columbia Local Area Dependencies: 2006*, BC Stats.

Fort St. James, with half of its after-tax income and 49% of its employment stemming from the forest sector, is the next most forest-dependent forest district in the province. In 2008, this region had already lost approximately 45% of its pine forests to the mountain pine beetle and this figure is projected to climb to 72% by 2015. Quesnel, at 46% of after-tax income and 48% of employment, Nadina (which includes the Morice and Lakes TSAs), at 45% of after-tax income and 46% of employment, and Vanderhoof, with 40% of after-tax income and 45% of employment, round out the top five forest districts in terms of economic dependency on the forest sector. Each of these is among the worst hit regions in terms of the pine beetle infestation.

There are ten forest districts in the province where the forest sector comprises more than 25% of basic employment



Source: BC Stats (BC Local Area Dependencies: 2006)

In addition to the obvious implications for the economy of the regions affected by the pine beetle outbreak, there are also some possible consequences for the environment, beyond the loss of significant portions of BC's pine forests. British Columbia's dying pine trees are becoming a growing source of greenhouse gases. Normally, a healthy forest helps reduce greenhouse gases by acting as a "carbon sink," absorbing carbon-dioxide from the atmosphere and keeping carbon trapped in the ground. However, the scope of the current pine beetle infestation has killed such a substantial number of trees that their ability to remove carbon-dioxide from the atmosphere has been reduced. In addition, as trees decay, they release carbon-dioxide into the atmosphere. In other words, the forest has been converted from a carbon sink into a source of carbon.

According to a report produced by scientists with Natural Resources Canada and the Ministry of Forests and Range, in the worst year of the pine beetle outbreak in BC, the carbon impact was equivalent to approximately 75% of the average annual direct forest fire emissions from all of Canada over the 1959 to 1999 period.[7] Said another way, in that one year, the combination of reduced carbon absorption and increased carbon emission was equivalent to about three-quarters of the impact of an average year's forest fires in Canada.

Where do we go from here?

One solution to curb the carbon footprint of the dead pine is to harvest the trees and process the wood, and then reforest the harvested area. Processing the trees will keep the carbon trapped in the wood and replanting the forest will restore its ability to remove carbon-dioxide from the atmosphere.

[7] W.A. Kurz et al (April 24, 2008), "Mountain pine beetle and forest carbon feedback to climate change," *Nature* v. 452, pp. 987-990.

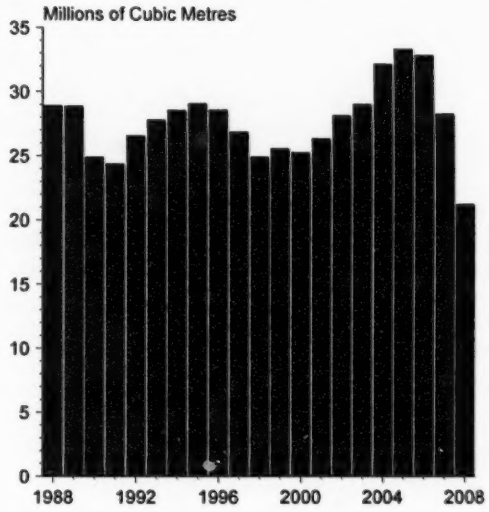
While this sounds simple, the economics of such a plan of action may make it more difficult, particularly because the economic value of beetle-killed timber is lower than that of healthy pine. In four mill trials funded by Forestry Innovation Investment, there was a clear difference between green logs and grey-stage logs in terms of wood grade. Virtually none of the grey-stage logs were of Grade 1 quality compared to about a third of green logs. Conversely, more than a third of the grey-stage logs were of Grade 4 quality, compared to 5 percent or less in green logs in three of the studies.[8]

This difference in grade, combined with increased losses in processing due to more brittle wood and other factors associated with grey-stage product, resulted in a loss in value ranging from 15.6% to 29.0% (See Table 3 at the end of this document).

The longer a grey-stage tree is left standing, the less value there is likely to be derived from it. On the positive side, new technologies and new methods of harvesting have been developed that have actually increased the harvest window, or the "shelf-life" of beetle-killed timber. Initially, it was estimated that the length of time that dead pine stands could economically be converted to timber was between four and eight years. However, with the advances in milling technology and different harvest practises, the shelf-life is now believed to be between eight and 12 years.

Nevertheless, given the sheer volume of beetle-killed timber, the time sensitivity for extracting economic value from the wood is compounding the problems for BC's forest industry, particularly in the context of the current economic situation. The drop in housing starts in the United States has reduced demand for building products and has resulted in lower prices for lumber. An influx of beetle-killed timber is exacerbating this situation by increasing the supply of wood at a time when demand is low. As BC's current markets for softwood lumber may not be able to absorb all the pine-beetle wood, new markets are being investigated.

BC's softwood lumber exports dropped substantially in 2008 as a result of the slumping global economy, particularly the downturn in the US housing market



Source: Statistics Canada

China is one such market that some see as a possible saviour for BC's forest sector given the size of the country's population and economy. However, there are some roadblocks to tapping this market, not the least of which is the economic feasibility of exporting wood to that country. Although a process has been developed such that China can import beetle-killed logs without violating Chinese log-health im-

[8] The mill in Quesnel had fewer high quality green logs than in the other three mills tests and also a greater quantity of Grade 4 green logs (17%), but the green logs still scored far better overall than the grey-stage logs.

port requirements, the costs of shipping the logs to China are high, such that the economic viability of these exports depends on current freight costs. There is the possibility that Russia will increase its log export tax to 80%, which may price their logs out of the Chinese market and allow BC companies to get a foothold. However, the province could realize a greater return on the wood if it were processed in some form before being exported.

To this end, efforts have been made to find alternative uses for the beetle-killed wood. The challenge is to find not only a viable product, but also a market for that product, whether it be domestically or abroad. Bioenergy is being touted as one potential use of the surplus wood, either for generating electricity by burning it, converting the wood into oil or ethanol, or manufacturing pellets to be used in industrial or residential furnaces.

An issue with using the wood for electricity generation is the relative expense compared to other alternatives, with transportation costs being the main deterrent. Currently, the most successful use of wood in generating power is within the forest sector itself, either by using the residual wood waste from production, or for the pulp and paper industry, by using "black liquor," a by-product of the pulping process. Obviously, in these cases, transportation is not an issue since the feedstock is created within the manufacturing facility itself from the material residual to the manufacturing process.

In the case of ethanol, the technology is not yet available to economically manufacture the product from biomass comprised of wood. For bio-oil, the process of converting the wood to oil is quite expensive and would have to be done on a large scale, which may not be economically viable with the pine beetle-killed wood. As a report by the Canadian Forest Service suggests, "It is not economical to build facilities that require substantial capital and long payoff periods specifically to use this supply of beetle-killed fibre given the lack of long-term feedstock."[9] In other words, once the beetle-killed wood has been harvested, the feedstock will be gone, so that building such a facility solely to use up the beetle-killed wood would not make economic sense.

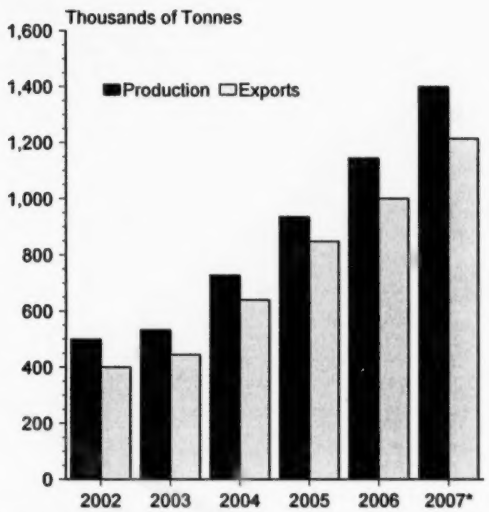
Of the bioenergy options, wood pellets may have the best potential for being economically feasible. These pellets are mainly manufactured from wood waste (primarily sawdust and shavings) residual to lumber or other wood product processing. They have several advantages over other fuel sources, including a consistency in size and shape that makes them easy to transport, a lack of artificial or toxic ingredients that makes them completely safe to handle and eliminates the possibility of toxic spills and, in addition, pellets are more efficient than other fuels and offer a net carbon reduction if they displace non-renewable fuels.

There are currently nine pellet plants operating in British Columbia. The pellet market is mainly restricted to Europe and, to a lesser extent, the United States, although consumption of pellets in the US is expected to grow, particularly in light of a significant consumer tax credit that was included in the economic stimulus package released in February. The credit is 30% (up to $1,500) of the cost for an efficient biomass burning stove purchased in either 2009 or 2010.

[9] Stennes, Brad and McBeath, Alec (2006), *Bioenergy options for woody feedstock: are trees killed by mountain pine beetle in British Columbia a viable bioenergy resource?* Canadian Forest Service, Natural Resources Canada, p. 14.

Canada is one of the top producers of wood pellets in the world and BC is the source of about two-thirds of Canadian pellet production. Around the world, most of the pellets produced are used domestically, but this is not the case in Canada as there is not as yet much of a domestic market for them. In fact, of those wood pellets that are exported, most are shipped from British Columbia.[10]

The bulk of Canadian wood pellet production is exported



*Estimate
Source: Climate Change Solutions

The top destination for wood pellets produced in BC is Europe, particularly the Netherlands, Belgium and Sweden. The Europeans were an early adopter of the use of pellets and are still well ahead of the rest of the world in terms of pellets as a fuel source.

One problem with shipping pellets to Europe is the cost of transportation. The various subsidies in place to encourage the use of wood pellets make it economically feasible to ship this product to Europe from BC, but if those subsidies disappear, so too could the profit for Canadian pellet producers.

The mountain pine beetle epidemic has the potential to inflict economic hardship on many communities in British Columbia, but new technologies and increased demand for environmentally friendly products could help the province weather the storm and possibly become a leader in developing alternative fuel sources using waste wood.

[10] Source: Wood Resources Quarterly

TABLE 1

Cumulative Pine Volume Killed (Red and Grey Attack) - Cubic Metres

Timber Supply Area	Total Timber Volume (1999)	Pine Volume (1999)	% Pine (1999)	Beetle-Killed Pine - Up to 2008	Killed as % Total Pine - 2008	Projection - Beetle-Killed Pine to 2015	Killed as % Total Pine - 2015
100 Mile House	110,436,352	57,597,952	52%	41,451,248	72%	43,740,912	76%
Arrow	50,683,296	7,895,984	16%	2,185,264	28%	5,447,632	69%
Boundary	43,424,592	15,011,120	35%	584,336	4%	8,603,296	57%
Bulkley	69,628,000	13,183,136	19%	1,030,576	8%	9,353,328	71%
Cranbrook	65,829,904	30,875,856	47%	2,818,784	9%	15,670,896	51%
Dawson Creek	107,675,632	30,889,120	29%	3,835,584	12%	21,289,760	69%
Ft. St. James (District)	285,258,608	109,503,152	38%	49,182,944	45%	78,484,976	72%
Golden	36,496,960	5,027,152	14%	960,720	19%	2,907,664	58%
Invermere	31,709,760	11,740,752	37%	1,401,712	12%	6,319,104	54%
Kamloops	208,026,928	58,842,848	28%	28,772,544	49%	38,891,392	66%
Kootenay Lake	58,975,120	12,981,616	22%	1,855,248	14%	7,678,656	59%
Lakes	110,554,240	71,046,736	64%	51,926,336	73%	53,357,312	75%
Lillooet	49,789,440	19,483,744	39%	3,849,920	20%	12,992,848	67%
Mackenzie	287,531,712	116,827,456	41%	10,810,432	9%	72,266,912	62%
Merritt	130,833,856	66,165,184	51%	13,468,560	20%	40,707,760	62%
Morice	132,865,936	57,078,896	43%	26,200,560	46%	39,556,000	69%
Okanagan	211,370,096	57,336,608	27%	7,023,408	12%	32,175,344	56%
Prince George (District)	248,976,896	78,034,352	31%	46,367,696	59%	48,685,520	62%
Quesnel	164,736,944	110,969,680	67%	89,527,600	81%	89,812,464	81%
Robson Valley	49,000,096	6,218,144	13%	1,334,784	21%	3,879,232	62%
Vanderhoof (District)	133,279,904	97,637,744	73%	70,217,120	72%	70,613,840	72%
Williams Lake	264,548,400	143,621,136	54%	84,178,864	59%	95,659,360	67%
Sub-Total	**2,851,632,672**	**1,177,968,368**	**41%**	**538,984,240**	**46%**	**798,094,208**	**68%**

Source: Ministry of Forests and Range

Model version BCMPB.v6, no management scenario (i.e., no harvesting occurs; projection for infestation only)

Data is presented for the 20 TSAs with more than 10% pine. The Prince George TSA is modelled as 3 separate management units (each forest district)

TABLE 2

Forest Sector Economic Dependencies - Top Forest Districts (2006)

Forest District	Employment	After-Tax Income
Mackenzie	70%	73%
Fort St. James	49%	50%
Quesnel	48%	46%
Nadina	46%	45%
Vanderhoof	45%	40%
Headwaters	33%	34%
Central Cariboo	32%	31%
Fort Nelson	24%	27%
Prince George	26%	25%
Chilcotin	26%	25%
North Island-Central Coast	24%	25%
100 Mile House	26%	24%

Source: British Columbia Local Area Economic Dependencies: 2006 (BC Stats)

TABLE 3

Comparison of Lumber Recovery and Value Losses for Four Mill Trials

Mill Site	Total LRF Loss	Lumber Value Loss	Combined Loss
Princeton	1.5%	14.1%	15.6%
Quesnel	7.1%	23.5%	29.0%
Prince George	8.2%	11.9%	19.0%
Vanderhoof	12.5%	5.7%	17.5%

Source: Forestry Innovation Investment

Note: LRF = Lumber Recovery Factor

TABLE 4
Comparison of Log Grades for Each Mill Test

Sample	Grade 1 (%)	Grade 2 (%)	Grade 4 (%)	Total (%)
Princeton green logs	32	67	1	100
Quesnel green logs	13	71	17	100
Prince George green logs	39	57	5	100
Vanderhoof green logs	34	61	5	100
Princeton grey-stage logs	0	67	33	100
Quesnel grey-stage logs	0	64	36	100
Prince George grey-stage logs	0	53	47	100
Vanderhoof grey-stage logs	1	63	36	100

Source: Forestry Innovation Investment

TABLE 5
Canadian Pellet Manufacturing - Thousands of Tonnes

Sample	2002	2003	2004	2005	2006	2007*
Production	499	533	727	935	1,145	1,400
Domestic Use	99	88	87	88	135	200
Exported to USA	230	210	265	265	400	450
Exported Offshore	170	235	375	583	600	765

*Estimated
Source: Climate Change Solutions (*Canada Report on Bioenergy 2008,* for Environment Canada, June 2008)